

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (Currently Amended) A reflection-transmission double type liquid-crystal display device comprising:

a transmission type liquid-crystal display panel including a liquid-crystal cell;

at least one illuminator disposed on at least one of side surfaces of said liquid-crystal display panel and capable of being switched on/off;

an optical path changing sheet which has a refractive index exhibiting a refractive index difference of not higher than 0.15 from a refractive index of a nearest liquid-crystal cell substrate, and which is bonded onto a back side opposite to a visual side of said liquid-crystal display panel through an adhesive layer having a refractive index exhibiting a refractive index difference of not higher than 0.20 from the refractive index of said nearest liquid-crystal cell substrate; and

a reflection layer disposed on a back side of said optical path changing sheet,

wherein said optical path changing sheet has continuous first optical path changing slopes, second optical path changing slopes and flat surfaces, each of said first optical path changing slopes faces said illuminator at an inclination angle in a range of from 30 to 48 degrees with respect to a plane of said optical path changing sheet for reflecting incident light from said illuminator toward said visual side of said liquid-crystal display panel, each of said second

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optical path changing slopes faces away from said illuminator at an inclination angle which is less than 90 degrees with respect to a plane of said optical path changing sheet and is greater than said inclination angle of said first optical path changing slopes, and each of said flat surfaces is inclined at an inclination angle of not larger than 10 degrees with respect to said sheet plane so that a projected area of said flat surfaces on said sheet plane is not smaller than 10 times as large as a projected area of said first optical path changing slopes on said sheet plane.

2. (Original) A reflection-transmission double type liquid-crystal display device according to claim 1, wherein said liquid-crystal display panel further includes a polarizer disposed on one or each of side surfaces of said liquid-crystal cell.

3. (Original) A reflection-transmission double type liquid-crystal display device according to claim 2, wherein said liquid-crystal display panel further includes at least one phase retarder disposed between said liquid-crystal cell and said polarizer.

4. (Original) A reflection-transmission double type liquid-crystal display device according to claim 1, wherein each of cell substrates for said liquid-crystal cell is made of an optically isotropic material.

5. (Currently Amended) A reflection-transmission double type liquid-crystal display device according to claim 1, wherein said ~~optical path changing sheet is provided as an optical~~

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~~path changing sheet including~~ first optical path changing slopes ~~forming ridgelines~~ are inclined at an angle of not larger than 30 degrees with respect to said side surface on which said illuminator is disposed; and said optical path changing sheet is disposed so that said optical-path-changing-slope-forming surface of said optical path changing sheet is located on said back side ~~(opposite to the visual side)~~ of said optical path changing sheet.

6. (Original) A reflection-transmission double type liquid-crystal display device according to claim 1, wherein a refractive index difference between said adhesive layer and said nearest liquid-crystal cell substrate and between said optical path changing sheet and said nearest liquid-crystal cell substrate is not larger than 0.10.

7. (Currently Amended) A reflection-transmission double type liquid-crystal display device according to claim 1, wherein said ~~optical path changing sheet includes a repetitive structure of prismatic structures having~~ first optical path changing slopes inclined at an inclination angle of from 35 to 46 degrees with respect to said sheet plane.

8. (Original) A reflection-transmission double type liquid-crystal display device according to claim 7, wherein each of said prismatic structures of said optical path changing sheet is constituted by a concave portion substantially shaped like a triangle in section.

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9. (Original) A reflection-transmission double type liquid-crystal display device according to claim 7, wherein said prism-like concave portions are constituted by continuous grooves extended from one end of said optical path changing sheet to the other end thereof in a ridgeline direction parallel to or inclined to said side surface of said liquid-crystal display panel on which said illuminator is disposed.

10. (Previously Presented) A reflection-transmission double type liquid-crystal display device comprising:

a transmission type liquid-crystal display panel including a liquid-crystal cell;
at least one illuminator disposed on at least one of side surfaces of said liquid-crystal display panel and capable of being switched on/off;

an optical path changing sheet which has a refractive index exhibiting a refractive index difference of not higher than 0.15 from a refractive index of a nearest liquid-crystal cell substrate, and which is bonded onto a back side opposite to a visual side of said liquid-crystal display panel through an adhesive layer having a refractive index exhibiting a refractive index difference of not higher than 0.20 from the refractive index of said nearest liquid-crystal cell substrate; and

a reflection layer disposed on a back side of said optical path changing sheet,
wherein said optical path changing sheet has optical path changing slopes and flat surfaces, each of said optical path changing slopes faces said illuminator at an inclination angle in a range of from 30 to 48 degrees with respect to a plane of said optical path changing sheet for

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reflecting incident light from said illuminator toward said visual side of said liquid-crystal display panel, and each of said flat surfaces is inclined at an inclination angle of not larger than 10 degrees with respect to said sheet plane so that a projected area of said flat surfaces on said sheet plane is not smaller than 10 times as large as a projected area of said optical path changing slopes on said sheet plane,

wherein said optical path changing sheet includes a repetitive structure of prismatic structures having optical path changing slopes inclined at an inclination angle of from 35 to 46 degrees with respect to said sheet plane,

wherein said prism-like concave portions are constituted by discontinuous grooves each of which has a length of not smaller than 5 times as large as a depth of said groove and in which a longitudinal direction of said groove is substantially parallel to said side surface of said liquid-crystal display panel on which said illuminator is disposed.

11. (Original) A reflection-transmission double type liquid-crystal display device according to claim 1, wherein light reflected by said reflection layer is diffused so as to be made incident on said liquid-crystal cell.

12. (Original) A reflection-transmission double type liquid-crystal display device according to claim 11, wherein at least said reflection layer, said optical path changing sheet or said adhesive layer for bonding said reflection layer to said liquid-crystal display panel exhibits light diffusing characteristic.

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13. (Original) A reflection-transmission double type liquid-crystal display device according to claim 12, wherein said light diffusion type reflection layer has a rough surface of fine prismatic structures, and a high-reflectance metal thin film disposed on said rough surface of fine prismatic structures, or wherein a light diffusing layer is disposed on an optical-path-changing-sheet-side surface of said high-reflectance metal thin film.

14. (Previously Presented) A reflection-transmission double type liquid-crystal display device according to claim 12, wherein said reflection layer comprises a high-reflectance metal thin film which is provided onto an optical-path-changing-slope-forming surface of said optical path changing sheet, the optical-path-changing-slope-forming surface being roughened, or onto an optical-path-changing-slope-forming surface of a light diffusion type optical path changing sheet; or

wherein said reflection layer comprises a high-reflectance metal thin film which is provided onto an optical-path-changing-slope-forming surface of said optical path changing sheet, said optical path changing sheet being bonded through a light diffusion type adhesive layer.

15. (New) A reflection-transmission double type liquid-crystal display device comprising:

a transmission type liquid-crystal display panel including a liquid-crystal cell;

at least one illuminator disposed on at least one of side surfaces of said liquid-crystal display panel and capable of being switched on/off;

an optical path changing sheet which has a refractive index exhibiting a refractive index difference of not higher than 0.15 from a refractive index of a nearest liquid-crystal cell substrate, and which is bonded onto a back side opposite to a visual side of said liquid-crystal display panel through an adhesive layer having a refractive index exhibiting a refractive index difference of not higher than 0.20 from the refractive index of said nearest liquid-crystal cell substrate; and

a reflection layer disposed on a back side of said optical path changing sheet,

wherein said optical path changing includes a plurality of continuous and adjacent, first and second optical path changing slopes, each of said first optical path changing slopes faces said illuminator at an inclination angle in a range of from 30 to 48 degrees with respect to a plane of said optical path changing sheet for reflecting incident light from said illuminator toward said visual side of said liquid-crystal display panel, each of said second optical path changing slopes faces away from said illuminator at an inclination angle of not larger than 10 degrees with respect to said sheet plane so that a projected area of said second optical path changing slopes on said sheet plane is not smaller than 10 times as large as a projected area of said first optical path changing slopes on said sheet plane.

16. (New) A reflection-transmission double type liquid-crystal display device comprising:

a transmission type liquid-crystal display panel including a liquid-crystal cell;

at least one illuminator disposed on at least one of side surfaces of said liquid-crystal display panel and capable of being switched on/off;

an optical path changing sheet which has a refractive index exhibiting a refractive index difference of not higher than 0.15 from a refractive index of a nearest liquid-crystal cell substrate, and which is bonded onto a back side opposite to a visual side of said liquid-crystal display panel through an adhesive layer having a refractive index exhibiting a refractive index difference of not higher than 0.20 from the refractive index of said nearest liquid-crystal cell substrate; and

a reflection layer disposed on a back side of said optical path changing sheet,

wherein said optical path changing sheet has a plurality of optical path changing means having a concave shape formed by first and second optical path changing slopes and flat surfaces interposed between said first and second optical path changing slopes, each of said first optical path changing slopes faces said illuminator at an inclination angle in a range of from 30 to 48 degrees with respect to a plane of said optical path changing sheet for reflecting incident light from said illuminator toward said visual side of said liquid-crystal display panel, each of said second optical path changing slopes faces away from said illuminator, and each of said flat surfaces is inclined at an inclination angle of not larger than 10 degrees with respect to said sheet plane.